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ARMS THE RAINS CAN'T TAKE

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UNITED STATES DEPARTMENT of AGRICULTURE
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To Farmers in the Upper Mississippi Valley:

You have been asked by your Government to help win the war. The farmer's share in this tremendous job is to increase the production of essential food and fibre on his farm. Food and fibre have been recognized as important to our war effort as guns, planes, and tanks.

To accomplish this assignment, it is imperative that we use the land wisely so as to conserve the soil, our greatest natural resource in war and in peace. For increased production is not only needed for 1942 but for as many years as the war lasts and for several years thereafter. Changes on the farm must be made with an eye on the future as soil productivity drops rapidly under poor land use and can be improved only after years of careful management or with costly fertilizers.

In 1932, plots were established on a dairy farm near La Crosse, Wis. Careful detailed measurements have been made on these plots, since, to measure soil and water losses and crop production under various cropping systems and control practices. So that you may have available the latest data, this publication has been revised and brought up to date. It includes conclusions and recommendations based on 9 years of investigation at the Upper Mississippi Valley Soil Conservation Experiment Station. These recommendations if followed will allow the required production with a minimum of soil waste.

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FARMS THE RAINS CAN'T TAKE

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An Experiment Station at Work

Farmers of Minnesota, Wisconsin, Iowa, and Illinois farm more than one-half of the grade-1 farm land in the United States and a large share of the grade-2 land. So great a heritage is worth preserving.

How has farm land in these States been used in the past? How can it best be used in the future?

Soil-erosion surveys show that nearly one-half of the entire area of these four States is seriously eroded. More than 13 million acres of formerly productive farm land have lost most of their topsoil and have become severely gullied.

The outlook for the future must be read in terms of the farmers' knowledge of how best to use the land. The goal is better crops and less loss of soil. Attempts to reach this goal must be based on knowledge of how to prevent harmful erosion.

To help the farmers get that knowledge scientists of the Soil Conservation Service, the Forest Service, and the Agricultural Experiment Station of the University of Wisconsin are working together at the Upper Mississippi Valley Soil and Water Conservation Experiment Station (fig. 1). They are measuring soil and water losses and are studying cropping systems on experimental plots (fig. 2) and fields.

The small experimental plots, most of them one-hundredth of an acre, are on a 16-percent slope of Fayette silt loam. A 16-percent slope is one having a vertical drop of 16 feet per 100 feet on the horizontal. This slope is no steeper than many of those farmed in the area served by the station. The plots are separated by metal strips. A basin at the foot of each plot catches the soil washed off during rains. Measurements of the soil in these basins give the soil loss from the plots.

The plots are put under different plant covers, and the soil and water losses under these treatments are measured from intense rains and from gentle rains. Soil loss is recorded from plots of different lengths on similar soil and slope to determine the effect of length of cultivated slope on erosion and run-off. Year-to-year observations of soil losses on these

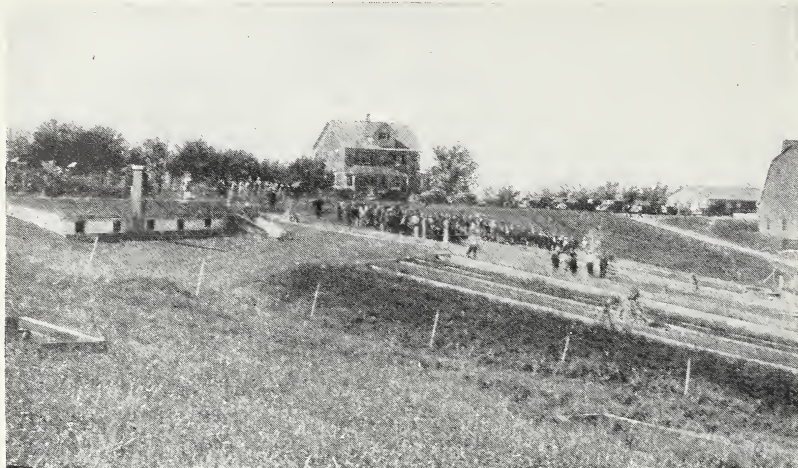


FIGURE 1.—The buildings and a few experimental plots on the Upper Mississippi Valley Conservation Experiment Station. The picture was taken during a field day attended by 200 farmers from central and eastern Wisconsin.



FIGURE 2.—Several of the plots in the erosion and run-off studies at the LaCrosse station. The corn plot at the right is in a 3-year rotation of corn, small grain, and clover. The corn plots at the left have been planted to corn continuously for 5 years.

plots permit a study of the possibility of lessening the erodibility of a soil by the use of soil-conserving crops.

On larger areas, terracing and strip cropping and grazing of woodlands have been tried out.

This farming of small plots and experimental fields is not done to produce corn or grain or hay. The main "crop" of the scientists is their

record of erosion and run-off. The end of their search, however, is not a file of facts about soil and water losses. They use these facts, in addition to the knowledge farmers have of their soils, to get answers to questions about which there is still doubt. From those answers come better ways of farming.

Along the Mississippi River in Minnesota, Wisconsin, Illinois, and Iowa are almost 18 million acres of farm land on which the soils are much like those at the experiment station. Farmers who live on this land can assume that the findings at the station are similar to what they would have been had the experiments been conducted on their own farms.

This report of the work of the station is largely in numerical terms, statements of the amount of soil loss and the amount of run-off from experimental plots and fields. The run-off from a plot is measured as the percentage of the total rainfall on that plot. Water losses from woodland and pasture are given in gallons per acre. Soil loss is stated in tons per acre.

In interpreting these figures on soil loss, ask what these losses would amount to on your farm in Minnesota, Wisconsin, Illinois, or Iowa. It may be well to think of the soil lost in terms of its depth and to ask what part of the total depth of the topsoil on your farm is represented by a loss recorded here as tons per acre. Assume that from an acre 140 tons of topsoil have been removed. This 140 tons is about the equivalent of 1 inch of soil spread over that acre.

How many inches of soil do you have to lose? The average depth of topsoil on the farms in the upper Mississippi Valley is 6 to 8 inches. One hundred and forty tons of this soil is one-sixth to one-eighth of all there is to lose.

Grass Makes the Best Cover

Like water from a tin roof, rain falling on bare slopes runs off almost as rapidly as it falls. Unlike the water off the roof, which runs clear, the water flowing down a bare slope carries with it a part of the surface over which it runs, the soil itself.

Put plant cover on the slope and less of the soil goes with the run-off. There is also less run-off. Station records for the 6-year period 1933-38 put side by side the soil losses from fallow land and from soils under a cover of grass, legumes, small grains, and corn. The grass was allowed to grow undisturbed. A comparison of these losses from plots of equal length and slope (fig. 3) is evidence that the type of plant cover on the land is one of the levers by which farmers can raise or lower the soil loss from their fields.

Among these plant covers, a good grass sod stands first as a conserver of soil. Only the most intense rains cause run-off from grass sod. During a year of normal rainfall there are only a few such rains, whereas run-off from fallow and cornland may occur during as many as 30 to 40 rains.

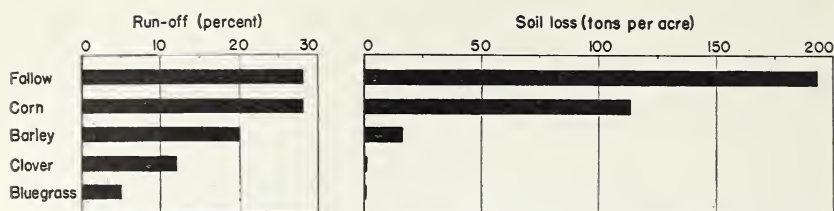


FIGURE 3.—The amount of soil loss from fallow land or from land under any one cover will vary from year to year, but the rank of each will very likely remain the same. Grain will lose less soil than fallow and grass less than grain. These are average annual losses of soil and water on a 16-percent slope of Fayette silt loam for the 6-year period 1933–38.

Not only is there less run-off from grass than from fallow land and corn-land; there is also less soil in the run-off. The run-off from grassland during a 6-year experimental period carried with it an average of only 0.09 ton of soil per acre annually, whereas the same rains that produced this run-off removed 192 tons of soil per acre annually from fallow land.

A plot planted to corn continuously showed an average annual soil loss of approximately 112 tons per acre during this same 6-year period. That amounts to more than two-thirds of an inch of soil each year.

The large soil loss from continuous corn, especially during years of exceptionally heavy rainfall, such as 1935 and 1938, shows that corn cannot be grown profitably on sloping land unless other crops, including legumes, are planted in rotation with corn to restore organic matter to the soil and to protect it by impeding run-off.

Under a clover-timothy mixture the annual soil loss has never exceeded $1\frac{1}{2}$ tons per acre. The average loss was 0.9 ton. The mixture of a dense-growing legume and grasses, such as timothy and brome-grass, protects the soil better than a legume alone. The longer the legume-grass cover remains on the ground the more dense the grass sod becomes, and the soil loss decreases correspondingly.

Barley annually has allowed an average soil loss of 17 tons per acre each year during the period of the experiment. Fall-sown grain is preferable to spring-sown grain in the area served by the station because fewer severe rains occur in the fall than in the spring. Furthermore, fall-sown grain makes sufficient growth by spring to afford some protection against erosion. Records at the station show that throughout the growing season high rates of run-off from small grain are to be expected unless there is a good growth of legumes in the grain. Small grains alone are not fully satisfactory as soil-conserving crops, but they furnish better protection than clean-tilled crops.

Hard Rains Take the Soil

Furthermore, small grain can be counted on to provide cover during only a few months of the year. If the cover is not on the land when the

rains come, it cannot protect the soil. Fields sowed to spring grain are not protected during April and May, when intense storms may be expected. And the hard rains do the damage. Each year 70 to 80 percent of the soil losses occur during three or four intense storms. Rain at the rate of 0.30 to 0.40 inch per hour causes relatively little erosion. Rain at the rate of $1\frac{1}{2}$ inches in 30 minutes, or thereabouts, even though it lasts for a relatively short time, washes gullies and removes tons of soil from unprotected fields.

It is against the intense rains, therefore, that the farmer must protect his soil. During one rain, corn plots on the station lost 70 tons of soil per acre, a loss equivalent to one-half of an inch of soil. Fifteen storms in 5 years took 74 percent of the soil that was lost from plots planted to corn. In a normal year there are 30 to 40 storms of sufficient intensity and duration to cause run-off from cornland. In this 5-year period, therefore, one-tenth of the storms, or less, took three-fourths of the soil.

The risk of leaving a sloping field open during intense storms is greater than most farmers care to take when they know what the risk is.

Last Year's Crop Affects This Year's Soil Loss

Soils should be anchored by a plant cover as much of the time as possible. Grass gives the most protection; but all the land cannot be kept in grass. Land under cultivation must be protected in some other way. That this can be done has been demonstrated at the station (fig. 4). It can be done only by growing the soil-depleting cultivated crops in rotation with grass or a grass-legume mixture.

A grass or legume crop protects the soil against erosion not only during the time it serves as a cover for the soil, but also after it has been incorporated in the soil. Similarly, the effect of a row crop extends beyond the year when it is grown. A row crop permits erosion while it is on the land. It also leaves the soil with less organic matter, and the less organic matter there is in a soil the more erodible it is. Last year's crop affects this year's soil loss.

Examples from the records of the station show this to be true. During the rain that occurred April 30 and May 1, 1936, a plot plowed for planting to corn lost 5 tons per acre. A plot planted to barley lost 25 tons of soil per acre. Why did the plowed plot lose less soil? The year before it had been in hay, which had been plowed in. The barley followed corn. Furthermore, though the soil on the plowed field was bare, the plowing had left it in a rough condition. The root system of the cover crop and the green manure that had been mixed into the soil by plowing in the hay residue had helped to make the soil on this plot less erodible than the soil on the plot planted to corn the year before.

Rough-plowed hayfields on the station have always lost less soil than fields that have been cultivated and planted to grain.

One might expect higher soil losses from plowed land since it is without cover and since the soil loss from fallow land is high (fig. 3). But plowed land that has been in a soil-conserving crop is protected by its rough surface and by the roots and organic matter in the soil left from this crop. The large loss recorded for fallow land is an annual loss from a plot left fallow 6 years in succession. During 5 of these 6 years there was no last year's crop in the soil.

Likewise, the 112-ton-per-acre loss from cornland shown in figure 3 is from plots planted to corn year after year. Erosion losses for corn following clover are much less. Corn following clover in a 3-year rotation allowed a soil loss of less than half that from the plot planted to corn



FIGURE 4.—Soil can be used without waste. In 1932 the elevation of both these plots was the same. For 6 years the plot on the left has been in a 3-year rotation of corn, small grain, and clover and the plot on the right has lain fallow. During this time the fallow plot lost 7 inches of soil, the plot in rotation lost less than 1 inch.

continuously. This difference in soil loss can be attributed to better crop growth and to the action of the clover-timothy sod incorporated in the soil the year before the corn was planted on the rotation plots.

Incorporating in the soil a green-manure crop puts organic matter into the soil. Decaying organic matter acts like innumerable tiny sponges. It makes the soil porous. A soil that contains much organic matter will absorb a large part of the rain that falls on it. The plant roots of the cover crop also bind together the soil particles so that they are less easily carried away by run-off.

Measurements have shown that when barley follows corn in a rotation the soil loss exceeds that from land which has grown barley continuously. This is probably due to the greater amount of organic matter stored in

the soil from continuous barley. On the plots in barley year after year organic matter is turned into the soil every fall. Barley annually has consistently lost less soil even though the crop production has been about one-half that of barley in the 3-year rotation—corn, barley, clover-timothy.

However, by the middle of June, when the barley has attained a good growth, the loss from barley in rotation is less than that from barley annually; for the legumes seeded with the barley have by this time produced a better cover for the ground than is given by barley alone on the annual plot. On a plot that contains little organic matter a good grass or grass-legume cover is the only effective protection against erosion.

Sloping Fields Lose Soil

We cannot change the soil type on our farms nor limit the intensity of the rains. But we can shield the soil from heavy rains by covering it with close-growing grasses and legumes. And by planting crops in a sequence that puts organic matter into the soil periodically, we can make soil less erodible during the time it is without cover.

We cannot change the slope of the land. But if we would not lose most of the soil from cultivated fields on sloping land in a short span of years, we must use cropping practices that in effect make long slopes shorter; for on short slopes the soil losses per unit area are less than on long slopes. It is more often necessary to reseed spring grain on a long slope than on a short one, as all farmers know.

The experiment at the station designed to measure the difference in soil losses on slopes of different lengths bears out the experience of farmers who cultivate sloping lands. Soil loss was measured on three plots laid out side by side. One plot is 36 feet long; one twice that long, 72 feet; and one about four times as long, 145 feet. For 6 years these plots were planted to corn, and in that time the 36-foot plot lost 70 tons of soil per acre annually, whereas the plot of twice that length lost 1.6 times as much and the plot four times as long lost twice as much (fig. 5). These

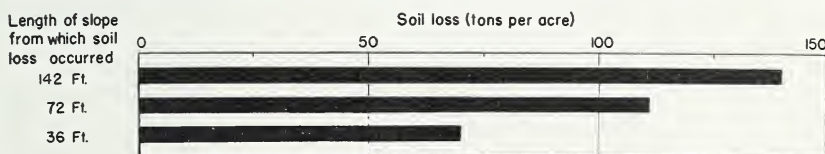


FIGURE 5.—Soil loss is less on shorter slopes. Both the 72-foot and the 36-foot plots are on a 16-percent slope. The upper part of the 145-foot plot has a slope of only 12 percent.

data show the danger in cultivating long slopes. Within a few years long slopes under continuous cultivation become badly gullied and will have light spots showing where subsoil has been exposed.

The same is true of steep slopes. The steeper the slope, other things remaining the same, the greater the soil loss. Water flowing down an

unprotected slope gains in speed as it flows, and the longer the slope over which it runs or the steeper the slope, the greater is its gain in speed. The shorter the distance of flow over unprotected soil, the less speed the water can gain and the less opportunity there is for it to concentrate. To decrease erosion on sloping lands, therefore, a good rule is to shorten slopes or to use a cropping system that in effect makes slopes shorter.

Shorten Slopes to Reduce Erosion

Terracing and strip cropping, widely used in the upper Mississippi Valley in conjunction with crop rotations, are a means by which farmers are decreasing soil losses on sloping fields.

Terracing breaks a long slope into a series of shorter ones. The terrace channel stops the water and carries it around the slope to a protected outlet. The length of slope on a terraced field is no greater than the distance between terraces.

Strip cropping does not stop the flow of water down a sloping field. But it makes shorter the distance over which water travels downward across unprotected soil and thereby interferes with its increase in velocity. Furthermore, when water from a corn strip reaches a hay strip, its manner of flow is changed. On the corn strip or newly seeded grain strip the flow is more readily concentrated and therefore the water cuts channels in the soil. As the water from the corn strip passes onto the denser vegetation in the hay strip it spreads out. As its velocity decreases, much of the sediment it carries is dropped so that there is less soil in the water that runs onto the next strip below.

Whereas terracing actually cuts a long slope into shorter ones, strip cropping breaks the uniform surface of a field into a series of strips on which the surface conditions are different. Since the flow of the water changes with a change in the surface over which the water runs, strip cropping in effect changes the length of slope. It reduces the dangers of cultivating long or steep slopes.

From the experiments with these means of making long slopes shorter have come some answers to questions farmers are asking about terracing and strip cropping on sloping fields.

Do terraces help to hold soil on a field? Can a terraced field be farmed as easily as an untterraced field? Are terraces difficult to maintain? Should they be on the level or on a grade? How can the terraces and outlet channels best be constructed?

Do yields on strip-cropped fields surpass those on fields not strip-cropped, and are the soil losses greater if strip cropping is not practiced?

Terraces Fit Contour Farming

Terraces slow down run-off and prevent dangerous accumulation of water by breaking the total flow from long slopes and turning a part of

the run-off to protected waterways alongside the fields. Since they follow the contour approximately they serve as guides for locating crop rows on the level. This combination of terrace and contour tillage greatly reduces loss of soil and generally increases the amount of water that enters the soil.

Maintenance of terrace ridges is also easy, if farming operations are parallel to the terrace ridges. By plowing the backfurrow to the ridge, station workers have maintained ridges at a suitable height without doing any other maintenance work on them. It has not been necessary to raise the height of a terrace ridge by regrading.

About terrace channels the experiments at the station have revealed these facts: Terraces with a very slight grade or fall, from 1 to 3 inches per 100 feet, have proved satisfactory. This slight fall permits a terrace channel to drain toward a protected outlet. In level terraces with no grade and with one end open, the water has a tendency to pile up in the terrace channel, where it drowns out crops and makes plowing, planting, or cultivating nearly impossible in wet weather.

As important as the proper construction of the terraces is the provision of suitable terrace-outlet channels, which carry the run-off from the field to a place where it can safely be discharged into stream, pasture, or woodland.

These terrace-outlet channels should be made ready before the terraces are constructed. Kentucky bluegrass has proved to be the cheapest and among the most effective protections for outlet channels draining terraces. Sodded outlets, however, can be used only on gentle slopes. Where the amount of water is large and the speed at which it runs down the channel is so great that bluegrass sod cannot withstand the force of the water, some type of hard-surface outlet channel must be used.

Strip Cropping and Crop Rotations Increase Yields

From another experiment have come records of crop yields and soil loss on two adjacent drainage areas under different cropping systems (figs. 6 and 7). The two areas had been farmed as one field, so they were about equally eroded at the time the experiment was begun, in 1932. They are nearly the same in percent of slope, length of slope, and soil. On both all tillage operations have been on the contour.

One field is strip-cropped (fig. 6). On the other a single crop was planted over the entire field each year in a 3-year rotation of hay, corn, and grain. This same rotation was used on the upper part of the strip-cropped field, which is divided into three strips 50 to 60 feet wide. These strips are on the contour. On each strip a 3-year rotation has been followed, so that one of the three strips is in timothy-clover hay, one in corn, and one in grain each year. On the lower, steeper part of this field a longer rotation is used. This strip was seeded down to an alfalfa-

timothy mixture in 1932, and it remained in hay until 1939, when corn was planted on the lower part of the strip.

By 1937 the area planted to a single crop each year was severely gullied (fig. 7). Many of the gullies were so deep they could not be crossed by a tractor. The lower half of the field was so severely gullied that costly reclamation was required. From these gullies has come the greater part of the soil that has been lost each year, and in 1 year that loss was 115 tons per acre.

On the strip-cropped field there was no gullying; for the alfalfa and timothy hay planted on the lower, steeper part of the slope in 1932 protected this slope at the point where gullies begin. On the upper part of the field there was some sheet erosion in the corn strips during the severe storms in 1935 and 1936. The heavy spring rains in 1936 caused some washing in the grain strips, but it was not necessary to reseed as it was on the other field, which was in grain that year. There was little loss of soil from the strip-cropped field because much of the soil removed from the corn and grain strips was deposited in the hay strips.

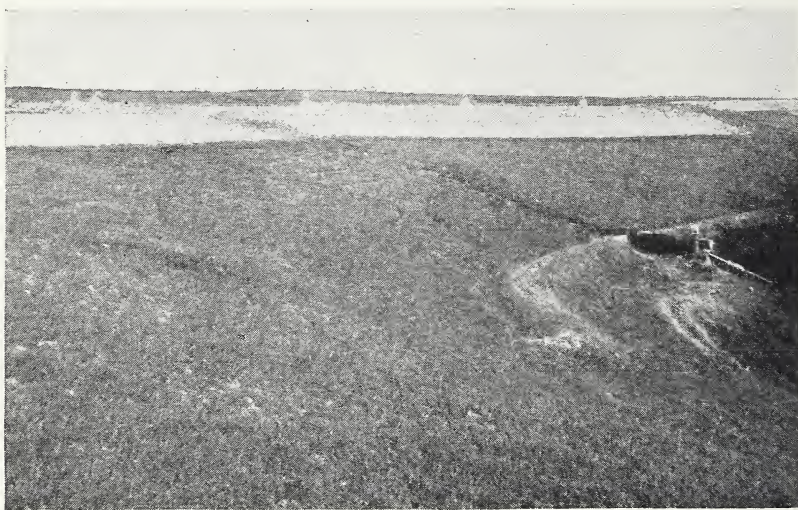


FIGURE 6.—The contour strips on the upper part of this field are planted in a 3-year rotation. The strip on the lower part of the slope was in hay from 1932 to 1939. This field adjoins the one in figure 7, which eroded severely under another cropping plan.

In 1937 equipment was installed on these fields to measure soil and water losses. The average soil loss for the years 1937-40 from the field not strip-cropped was 27.1 tons per acre, whereas that from the strip-cropped field was only 3.1.

During these 4 years the field not strip-cropped was in hay 2 years, in corn 1 year, and in barley 1 year. The average yield of hay for the 2 years was 1.18 tons. The corn yield was 35.6 bushels and the barley yield 20.8 bushels.



FIGURE 7.—This slope is too steep to be used for a 3-year rotation of hay, corn, and barley. That rotation permitted severe gullying.

Corresponding yields from the strip-cropped field were 2.50 tons of hay, 43.0 bushels of corn, and 41.9 bushels of barley. The yield of hay on this field was the average yield from the strips in hay the years the other field was in hay. The yield of corn is from the strip in corn the year the other field was in corn, and the yield of barley is from the strip in barley the year the other field was in barley.

A Comparison Between Grazed Woodland and Pasture

Slopes too steep for profitable cultivation under terracing and strip cropping should be used for either pasture or woodland. Experiments

YEAR	WOODS	COW-DAYS OF GRAZING PER ACRE	OPEN PASTURE
1935		68	141 
1936		66	143 
1937		84	157 
1938		64	130 

FIGURE 8.—Wooded areas provide relatively little nourishment for livestock.

at the station have shown that steep wooded slopes produce much less pasturage than land devoted exclusively to grass. Over a 4-year period heavily shaded sod under a forest stand on a 25- to 35-percent slope yielded no more than one-half the grass obtained from a good open pasture moderately grazed (fig. 8).

Furthermore, when forested slopes as steep as 25 to 35 percent are grazed, someone pays dearly for the scant forage they provide. Sometimes the farmer or his neighbor pays in terms of increased run-off and eroding plow lands below the pasture. Sometimes the public pays in increased flood damages.

If for lack of pasture land on a farm a 25- to 35-percent woodland slope must be pastured, it is advisable, as in most humid regions, to clear off the trees and attempt to develop a good sod. This may be accomplished on the better soils, such as the silt loams. On the LaCrosse station, a watershed with a maximum slope of 35 percent was cleared of trees in 1931. No seed or fertilizer was used. The sparse bluegrass under the trees spread when the shade was removed and produced an excellent turf, which still has a good carrying capacity. If such steep slopes must be grazed they must be carefully managed. Overgrazing results in gullying where run-off concentrates. If these slopes are well managed, run-off and soil loss will be negligible, and fair or better pasture will be obtained, depending on the productivity of the soil.

That the run-off from grazed woodlands is relatively high is borne out by the record of run-off from woodlands on the station for the years 1935-38. The same is true of soil loss. Though the average soil and water losses from woodlands on the station for the years included in this report are not high, a comparison of these losses with those from ungrazed woodlands and pasture shows a marked difference in the water-holding capacity of soils under these different types of land use.

The soil and water losses from land used for pasture are, of course, not the only facts to be considered in planning for pasture management. They are only a part of what must be taken into account in determining the use to which an area can best be put.

Here is the record of run-off from woodlands on the station from 1935 to August 1, 1941. In 1935, a year of unusually heavy rainfall, the grazed woodland lost 28,950 gallons of water per acre in run-off, whereas the ungrazed woods of even steeper slope lost only 515 gallons. Run-off from a recently cleared, moderately grazed bluegrass pasture, having the same slope and soil type as the wooded areas, totaled 10,650 gallons. This is more than 20 times as much water as was lost from the ungrazed wooded area, but it is only a little more than one-third the amount lost from the grazed woods.

Between August 1 and 6, 1935, a series of intense rains fell, causing some of the most severe floods of the last 30 years along creeks and small rivers in southwestern Wisconsin. During this critical period the amount of run-off from ungrazed woods on the station was only one forty-seventh of that from grazed woods and less than one-fifteenth of the amount lost from the moderately grazed open pasture of similar slope.

Even when the ground is frozen, ungrazed woods more effectively prevent high run-off than grazed woods or open pasture. In March 1936, snow melting on frozen ground caused a loss of 735 gallons of water per acre in the ungrazed wooded area, the entire run-off for the year. However, the grazed woods during that same month lost four times as much water in run-off and the open pasture area lost twice as much.

Between March 24, 1936, and August 1, 1941, all the rain and snow falling on the loose, porous litter-covered soil of the ungrazed wooded tract soaked into the ground. During the same period, the grazed woods yielded run-off amounting to 29,000 gallons per acre.

Variations in the amount of soil lost through erosion from 1935 to 1941 parallel the variations in run-off for these years. In 1935, a year of heavy rainfall, the soil loss on grazed woodland was more than three times as great as in the 6 years 1936-41. On woodlands, as on cultivated fields, it is the hard rains that take the soil.

A comparison of the losses from grazed and ungrazed woodland and from pasture during any single year also shows soil losses that parallel the run-off from these areas. The highest run-off and the highest soil loss are from grazed woodland. The average annual soil loss from grazed woodland is more than twice as great as the combined losses from protected woodland and grassland, and the soil losses from pasture are unusually high. Most of the soil lost from the pasture was from the raw banks of a gully that was formed before the experiment was begun.

Do's and Don'ts in Conservation Farming

How shall I go about putting erosion-control measures to work on my farm? That is a question every farmer is asking who wants to keep the productive topsoil that still remains on his farm.

Station workers recommend an inventory of soil resources. Go over the farm carefully. Note where the gullies occur and how many there are; notice the small ditches forming in straight-rowed cornfields on sloping land after heavy rains; decide what crops should be grown on this field, and what on that. Then plan the farm so as to keep erosion in check on every acre of the farm. Assign each acre to its proper use and employ whatever farm practices are needed to make that use productive.

A visit to the nearest soil conservation demonstration project, SCS-CCC camp demonstration area, or soil conservation district will give valuable pointers on erosion control.

The following specific recommendations can be made to farmers in southwestern Wisconsin, southeastern Minnesota, northeastern Iowa, and northwestern Illinois:

1. A good rotation including legumes and grass is essential. Practice long rotations on steep slopes, rotations in which grass and hay are left on the land for 3 or more years.
2. Restrict cultivated crops to slopes of less than 18 percent.
3. Put slopes of 18 to 25 percent in permanent hay or pasture. Slopes of more than 25 percent should not be grazed. But if it is necessary to pasture land this steep, extreme care must be exercised to prevent overgrazing, or severe gullying will occur where run-off concentrates.

4. Confine clean-tilled crops, such as corn, to level or nearly level land. If such crops must be planted on sloping land, practice contour strip cropping or terracing or both, with a good rotation.

5. Usually, corn should not be planted on sloping ground 2 years in succession unless it is necessary to do so in order to control weeds.

6. Leave natural drainageways in the fields protected by vegetation. Establish grass mixtures in unprotected drainageways. Leave grassed drainageways wide enough to care for all the concentrated water likely to pour down them.

7. To reclaim severely eroded fields, put them in hay, pasture, or timber and provide for the safe disposal of run-off.

